RIMPAC-08 Planning and Support and OAML Certification

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LONG-TERM GOALS

Electro-optical identification (EOID) systems are playing an increasingly important role in mine countermeasures (MCM) operations. EOID systems, and other MCM assets, can be used more effectively when tactics and mission planning account for the state of the battlespace environment. The long-term goal of several ONR programs in the Ocean, Atmosphere & Space Division is to develop and transition systems and software to survey the battlespace environment and provide performance estimates for EOID systems operating in that environment. The environmental characterizations and EOID performance predictions are provided to MCM commanders and mission planners anywhere around the world in near-real-time to aid in asset allocation and the development of an appropriate and effective course of action.

OBJECTIVES

The objectives of the RIMPAC-08 demonstration were:

- To have US Navy and DoD personnel collect METOC data using Webb Research Slocum coastal gliders equipped with comprehensive suites of optical and physical sensors. The glider configured with environmental sensors for airborne mine countermeasures (AMCM) support is referred to as an autonomous battlespace profiler (A-BSP).

- To demonstrate the coordination and re-tasking of multiple gliders operating in different areas simultaneously. Glider control, data processing, and communications were centralized at the Naval Oceanographic Office (NAVOCEANO) Glider Operations Center (GOC). The MCM Commander (MCMC) and AMCM commander provided guidance for glider re-tasking.

- To demonstrate EODES performance prediction and mission planning tools for EOID systems. METOC data collected by the A-BSPs was provided to the EODES models in near real-time. The EODES performance prediction tools produced estimates of EOID system effectiveness in the area of operations prior to and during AMCM operations. The METOC data and EOID performance estimates were transmitted electronically to the MCMC and AMCM commanders aboard the USS COMSTOCK throughout the exercise.

In addition, EODES software was submitted to the Oceanographic and Atmospheric Master Library (OAML) for certification as a Navy standard model. To prepare the software package for evaluation, a

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portable, stand-alone executable was developed and full documentation was provided in compliance with OAML standards and practices.

APPROACH

A schematic of the RIMPAC-08 glider control, communications, and data processing is illustrated in Figure 1. The goal of the demonstration was to collect in-situ environmental data using sensor packages carried on Webb Research Slocum coastal gliders, transmit that data over secure satellite and internet communications channels, process the data using EODES software to produce performance predictions for Navy EOID assets, and present the data and performance estimates to commanders in the field to aid in developing mission plans and tactics. Glider control and data processing were centralized at the Naval Oceanographic Office (NAVOCEANO) Glider Operations Center (GOC). Data telemetry occurred in near real-time so that battlespace environmental information and EOID performance predictions reached commanders in the field on a twice-daily basis.

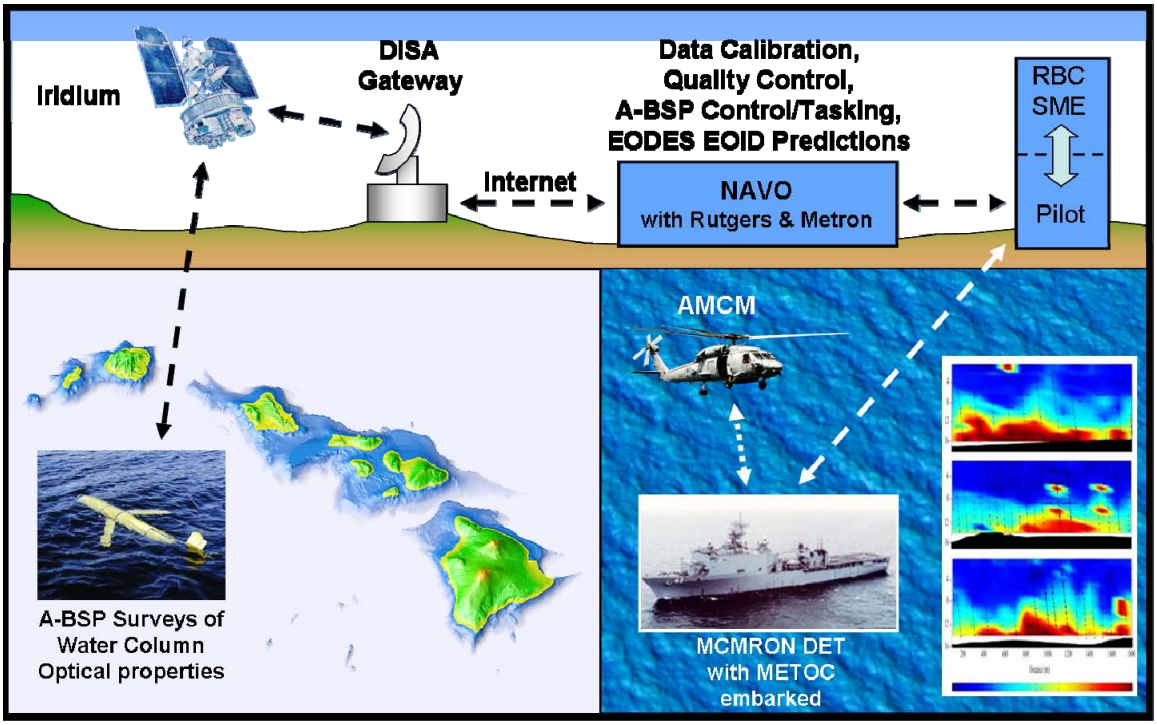

Figure 1: Schematic of data flow, glider control and communications, and MCM performance prediction products used for RIMPAC demonstration.

The demonstration was centered at the Naval Oceanographic Office (NAVOCEANO) Glider Operations Center (GOC) at Stennis Space Center, MS (POC: Kenneth Grembowicz and Dr. Kevin Mahoney). The GOC piloting and data communications CONOPS are diagrammed in Figures 2 and 3, respectively. Glider deployment and retrieval were performed by Naval Oceanography Mine Warfare Center (NOMWC) personnel (POC: LT James Coleman), who also coordinated our on-site operations with Third Fleet. Glider support and training were provided by Rutgers University (RU), and Rutgers personnel were on hand in Hawaii during the exercise to recover the gliders as needed (POC: Prof.

Oscar Schofield). Metron, Inc. provided the EODES electro-optical identification (EOID) systems models (POC: Dr. Thomas Giddings). Metron also drew up the demonstration test plan, provided organizational assistance among team participants, and helped coordinate with Third Fleet organizers. The entire project was overseen by Dr. Steven Ackleson of the Office of Naval Research (ONR).

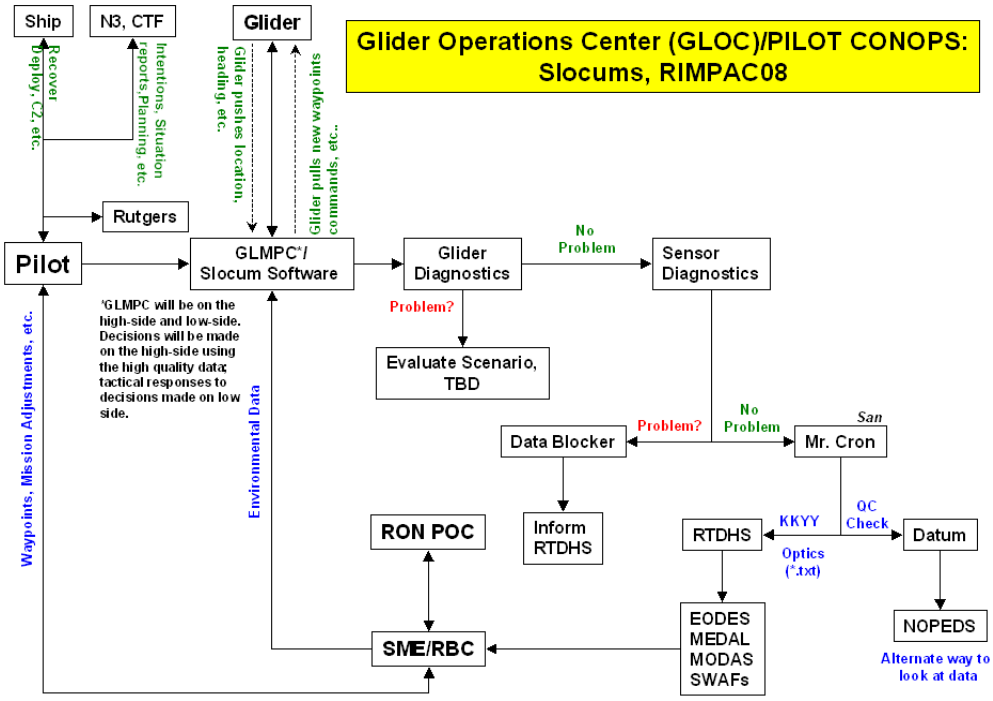

Figure 2: Schematic of glider piloting operations, centralized at the NAVOCEANO GOC.

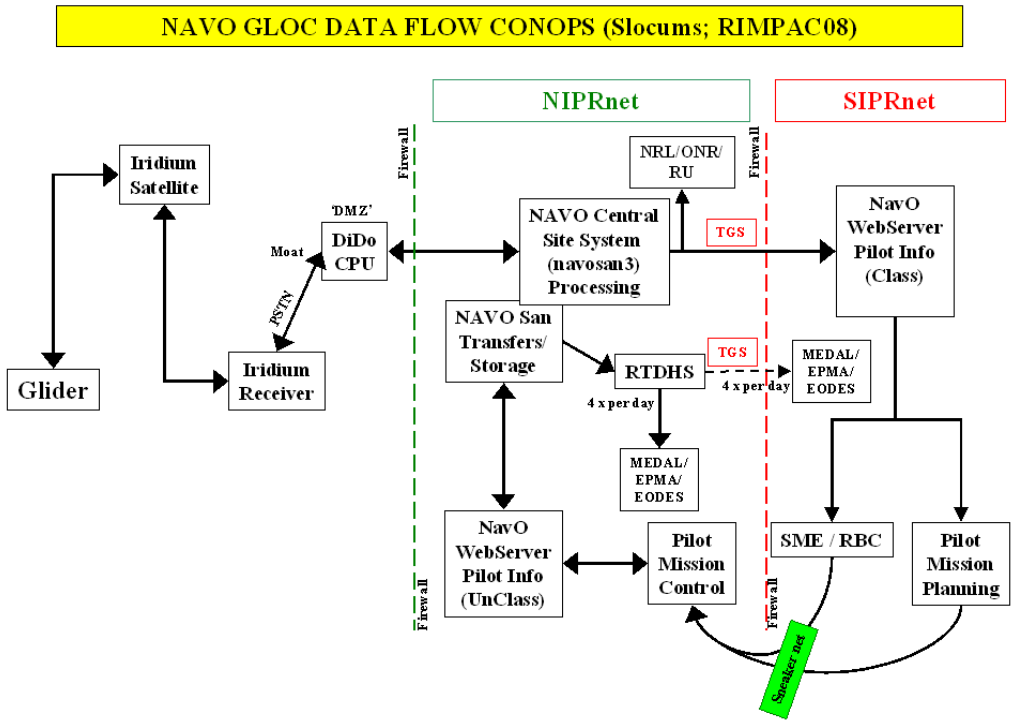

Figure 3: Data flow concept of operations (CONOPS), centralized at the NAVOCEANO GOC.

WORK COMPLETED

Metron was primarily responsible for developing the RIMPAC-08 glider test plan with the support of all team participants (ONR, NAVOCEANO, NOMWC, Rutgers, Metron). This effort involved organization and coordination among team participants and with representatives of other demonstrations taking place during the exercise. As it was being developed, the glider test plan was integrated into the exercise program during three planning conferences in San Diego, CA involving the Third Fleet planning committees and other exercise participants.

Metron developed automated data processing software that provided an interface between the optical sensor data and the EODES models during the RIMPAC-08 exercise. The data processing was automated so that minimal user interaction was required to process data around the clock and in near real-time. A data visualization tool, shown in Figure 4, was developed to display the performance prediction data in accordance with NAVOOCEANO/NOMWC requirements.

Metron also prepared a stand-alone EODES performance prediction tool for submission to the OAML review process. This involved the preparation of a Preliminary Engineering Change Proposal (PECP), several briefings to the OAML Software Review Board (SRB), and the compilation of detailed software documentation (Software Design Document, Software Requirements Specification, and the Software Test Description) describing the design, requirements, and validation of EODES models.

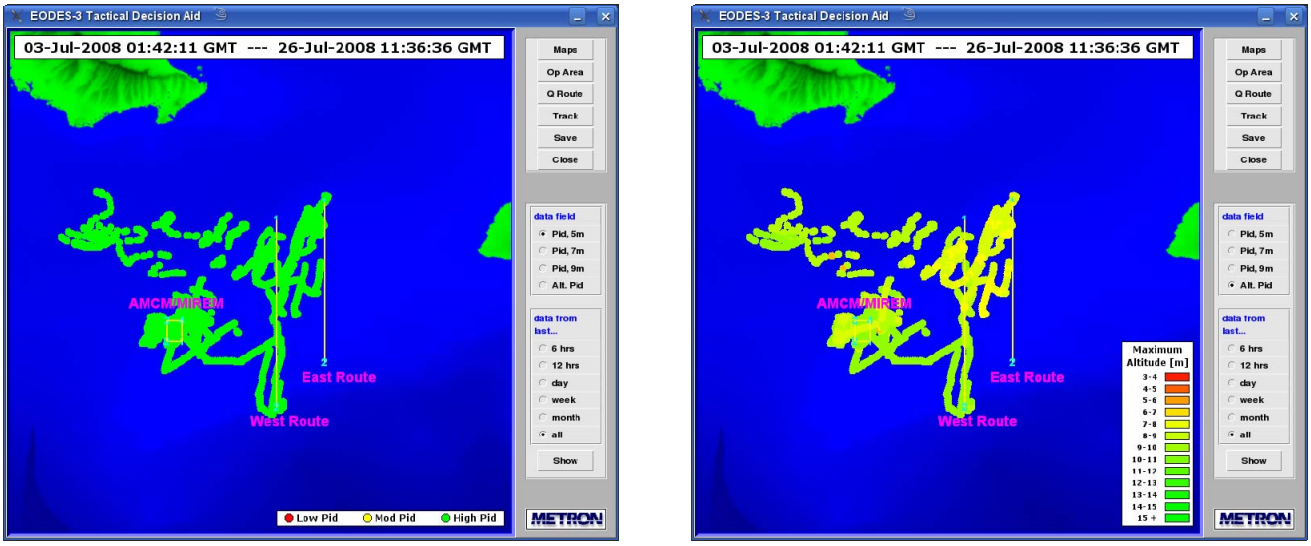

Figure 4: Graphical user interface (GUI) used to display performance prediction products: the probability of identification at a specified altitude (left), and the maximum recommended sensor altitude to achieve imagery of sufficient quality to permit target identification (right).

RESULTS

Gliders were successfully deployed and retrieved by NOMWC and NAVOCEANO personnel. The team also successfully demonstrated the ability to control several gliders remotely and simultaneously from the NAVOCEANO GOC. The Slocum gliders were tasked to survey different areas of operational interest in a coordinated way and so as to avoid conflicts with other operations in the area. Raw glider data was transmitted by Iridium satellite phone, and over a secure internet connection, to the NAVOCEANO GOC. This data was processed using EODES performance prediction models to provide assessments of EOID effectiveness in the operational area. Summaries of optical environmental data and EOID performance predictions were provided twice daily to a METOC officer on the USS COMSTOCK (LT J. Tim Uncapher, NOMWC), who presented the reports to MCM and AMCM commanders. A sample Optical Environment product is shown in Figure 5.

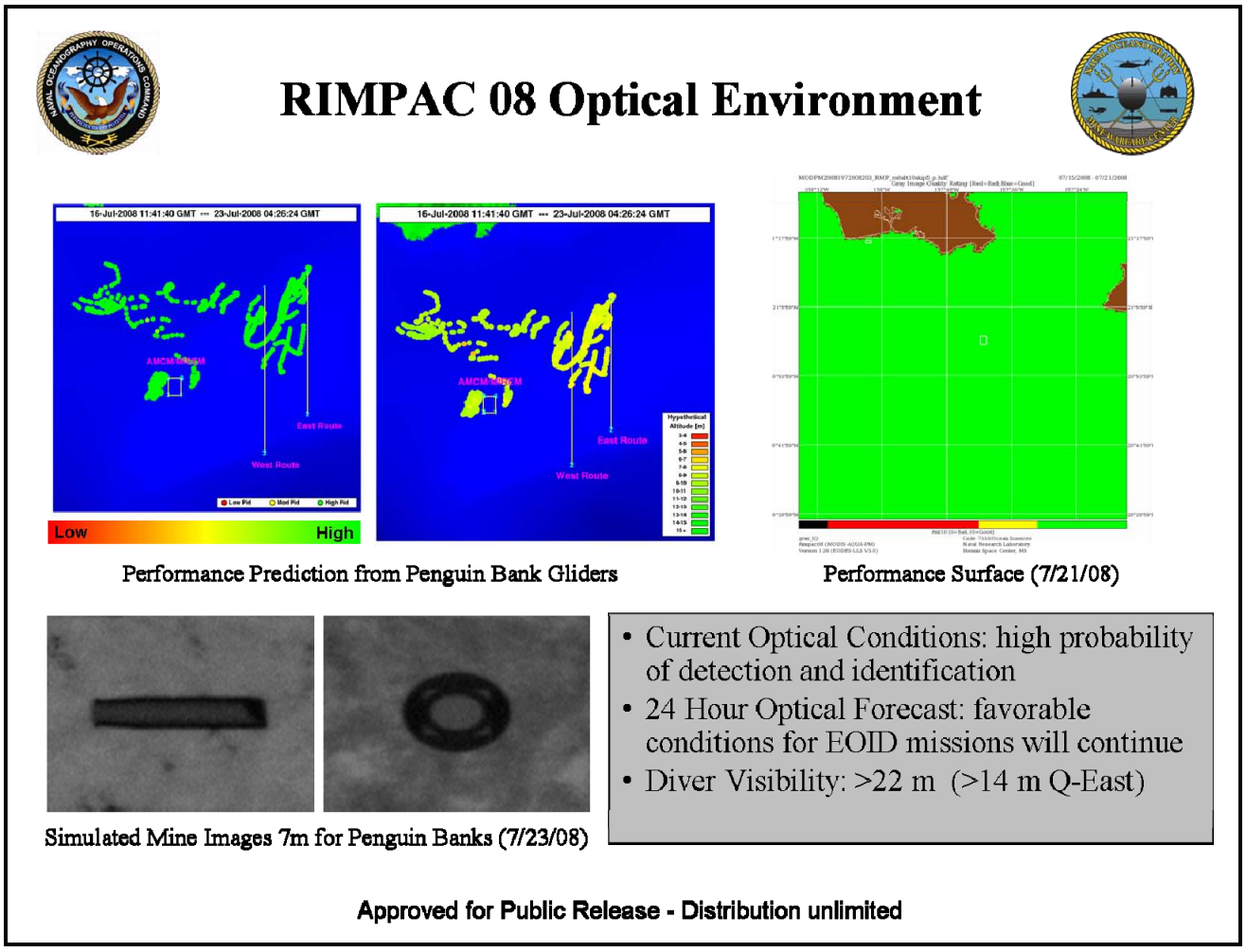

Figure 5: Example of the optical environment/EOID performance prediction product.

IMPACT/APPLICATIONS

The ability to provide near real-time characterizations of the battlespace environment and to relate this information to the operational effectiveness of MCM systems, will aid in the development of effective MCM tactics and mission plans. The environmental characterization and system performance predictions are of direct relevance to MCM commanders and mission planners as they formulate an appropriate course an action to make effective use of available time, assets, and resources.

TRANSITIONS

The Webb Research Slocum coastal gliders and the Metron, Inc. EODES electro-optical performance prediction model are in the process of transitioning to the Naval Oceanographic Office (NAVOCEANO). NAVOCEANO has already acquired several gliders, and EODES models are currently in the OAML certification process.

RELATED PROJECTS

The EODES models were developed under the ONR project entitled "A Comprehensive Model for Performance Prediction of Electro-Optical Systems" (contract number N00014-06-C-0070). This work is being carried out by Metron, Inc. The goal of this project is to develop high-fidelity, validated models for electro-optical imaging systems. The models provide performance estimates for EOID systems based on in-situ measurements of optical properties in the operational areas. The electro-optical models are also capable of providing realistic simulations for a variety of electro-optical imaging systems to support system design and evaluation, to assist in operator training, and to inform investment/procurement decisions.

PUBLICATIONS

[1] T. E. Giddings and J. J. Shirron, "Performance Prediction for Electro-Optical Mine Identification Systems," *8th Symposium on Technology and the Mine Problem*, MINWARA, Monterey, CA, 2008.

[2] T. E. Giddings and J. J. Shirron, "Performance Prediction for Underwater Electro-Optical Mine Identification Systems," *Ocean Optics XIX Conf. Proc.*, Barga, Italy, 2008.